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First record of the genus *Graeconiscus* Strouhal, 1940 (Isopoda, Oniscidea, Trichoniscidae) in the Iberian Peninsula with the description of a new troglobitic species

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Abstract

Graeconiscus gevi **sp. nov.**, a new troglobitic terrestrial isopod (family Trichoniscidae, subfamily Haplophthalminae), is described. The specimens of the new species are found in the Cueva del Yeso III, in the province of Málaga (SE Spain). *Graeconiscus gevi* **sp. nov.** is closely related to *Graeconiscus thermophilus* (Çaglar, 1948), an oculate species from Turkey and some Eastern Mediterranean islands. The morphological differences between both species are discussed and illustrated by SEM images of specimens from Málaga and Cyprus. The studied material represents the first record of the genus *Graeconiscus* in the Iberian Peninsula.

Keywords

Iberian Peninsula, cave biodiversity, terrestrial isopods, Haplophthalminae, new species

Introduction

Within the family Trichoniscidae, the subfamily Haplophthalminae is characterized by presenting, among other characters, a complex tergal ornamentation that contrasts with a remarkable homogeneity in its sexual characters. For this reason its classification

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has been based generally on body ornamentation (see Vandel 1960; Schmölzer 1965; Andreev 2004; Taiti and Bedek 2009).

So far, 14 species of Haplophthalminae belonging to the genera *Balearonethes*, *Haplophthalmus*, *Iberoniscus* and *Moserius* have been recorded in the Iberian Peninsula and the Balearic Islands (Legrand and Vandel 1950; Vandel 1952; Dalens 1977; Cruz and Dalens 1989; Reboleira et al. 2015). More recently, the genus *Baeticoniscus* (Garcia et al. 2020) has been described, with only one species.

In the framework of biospeleological studies which have been carried out in the south and southeast of the Iberian Peninsula, several specimens have been collected. Based on their morphological characters, we include them in the genus *Graeconiscus* Strouhal, 1940, known so far from the eastern Mediterranean islands, continental Greece, North Macedonia and western Turkey (Schmalfuss 2003; Alexiou and Sfenthourakis 2013) as well as from North Africa (Morocco) (Taiti and Rossano 2015) but not from the Iberian Peninsula.

The specimens collected from a cave in the province of Málaga, due to their specific combination of morphological features, have been included in a new species, *Graeconiscus gevi* sp. nov., which is described and fully illustrated in this article. It is also proposed to include the specimens recorded in Morocco by Taiti and Rossano (2015), tentatively identified as *G. thermophilus* (Çaglar, 1948), as part of the new species, since their small morphological differences in comparison to those of Spain do not seem sufficient to be considered as belonging to a different species.

Material and methods

Several specimens have been dissected under a stereomicroscope (Euromex NZ). For its morphological study, appendages, mouthparts and tergites have been mounted in micropreparations using glycerin or Faure liquor as appropriate, after treatment in some cases with Amann's lactophenol. The drawings have been made using a camera lucida attached to an optical microscope (Olympus CH30). The tergal structure of one specimen has been analyzed under a scanning electron microscope (Hitachi S-3400N). The final illustrations were prepared according to the method described by Montesanto (2015) and with the additional help of a drawing tablet (Wacom Intuos). The specimens of the new species have been directly compared to others of *G. thermophilus* , collected in Cyprus, which have also been examined under a scanning electron microscope.

Type locality and habitat

The Cueva del Yeso III (Fig. 1A, B) is a cave located in the municipality of Antequera (Málaga, Spain). The cave is 700 meters long and 61 meters deep and it is set in Triassic formations composed of large gypsum banks (Wallace and Berrocal 2002). The specimens were collected on bat guano.

Figure 1. Cueva del Yeso III of Antequera, Málaga, Spain **A** exterior of the cave **B** view of the interior (Photos provided by Baltasar Felguera, G.E.A., Campillos).

Depositories

MNCN: National Museum of Natural Sciences-Museo Nacional de Ciencias Naturales, Madrid, Spain. MBCN: Balearic Museum of Natural Sciences-Museu Balear de Ciències Naturals, Sóller, Mallorca, Spain. CLLG: Lluc Garcia personal collection, Sóller, Mallorca, Spain.

Results

Family Trichoniscidae Sars 1989
Subfamily Haplophthalminae Verhoeff, 1908
Genus *Graeconiscus* Strouhal, 1940

***Graeconiscus gevi* sp. nov.**
http://zoobank.org/60367B28-51C4-4B61-98D3-00CD706DB836
Figs 2–4

Graeconiscus thermophilus. – Taiti and Rossano 2015: 2073, figs 3–5.

Etymology. Derived from G.E.V., the acronym in Spanish of the Villacarrillo Speleological Group, for its great contribution to the knowledge of the subterranean biodiversity of the Andalusian region.

Examined material. ***Holotype.*** Spain • 1 male; Málaga, Antequera, Cueva del Yeso III; ETRS89 UTM 30S 345702 4094826, 441 m a.s.l.; 27 Apr. 2008; Toni Pérez-Fernández leg.; MNCN 20.04/12093. ***Paratypes.*** Spain • 3 males, same data as holotype; MNCN 20.04/12094, MNCN 20.04/12095, MNCN 20.04/12096. 4 females, same data as holotype; MNCN 20.04/12097, MNCN 20.04/12098, MNCN 20.04/12099, MNCN 20.04/12100. 1 male, 3 females, same data as holotype; CLLG 153. 1 male, 2 females, same locality as holotype, 26 Sep. 2009; Toni Pérez-Fernández leg.; CLLG 185. 1 male, 3 females, same locality as holotype; 28 Sep. 2008; Toni Pérez-Fernández leg.; CLLG 183. 1 male, 2 females, same locality as holotype; 29 Mar. 2008, Toni Pérez-Fernández leg.; CLLG 144.

Non type material. Spain • 7 damaged specimens; same locality as holotype; 24 Oct 2009; Toni Pérez-Fernández leg.; MBCN 23370.

Comparison material. *Graeconiscus thermophilus.* Cyprus • 5 males, 3 females; Loutra Afroditis; 4 Feb. 2020; Spyros Sfenthourakis leg.; CLLG 582.

Diagnosis. A blind and unpigmented species of *Graeconiscus*. Head with central anterior tubercle bilobed; posterior row of tubercles with the central ones almost fused. Pereon-tergites 1–6 with four individualized rounded, swollen, tubercles (2+2) not reaching the pereonites hind margin. Seventh pereonite with two large paramedian rounded, swollen, tubercles not reaching the hind margin. Pleonite 3 with a single, large and swollen, transversal tubercle.

Description. Maximum size observed: 3.2 mm (female), 3 mm (male). Body unpigmented. Eyes absent. Contour regularly ovoid, without interruption between pereon and pleon (Figs 2A, 4A–D). Pereon tergites very convex, with epimera expanded towards outside. Pleon epimera directed backwards. Cephalon (Fig. 4B) with triangular frontal lobe, apically rounded, and almost quadrangular lateral lobes with rounded anterior margin; head with 1 large central bilobed tubercle and 2 accessories; maxillipedal segment with 4 tubercles, central ones almost fused. Pereon-tergites with 4 rounded tubercles (2+2), slightly longer than wide in tergites 1–4, larger and swollen in 5–6, without exceeding its hind margin; pereonite 7 with 2 large paramedian rounded tubercles and small rugosities in its anterolateral part. Pleonite 3 with single, large and rounded, transverse tubercle, wider than long (Fig. 4C, D). Telson basally trapezoidal, with straight hind margin. Uropods: exopod longer than endopod. First antenna (Fig. 2C) tri-segmented; last antennular article longest, with 3 aesthetascs. Second antenna (Fig. 2B): flagellum with 3 poorly distinct articles; basal article with 2 thin aesthetascs; second article with 3–4, thicker. Mandibles with strong molar teeth. Right mandible (Fig. 2G) with 1 free penicil near the *lacinia mobilis*; left mandible (Fig. 2H) with 2 free penicils. Maxillule (Figure 2E): external branch with 5+4 undivided teeth; internal branch with 3 penicils, external penicil twice larger than internal ones. Maxilla (Fig. 2F) with bilobed distal part; internal lobe with 14–15 sensillae; external lobe with 3–4 sensilla and fine and long hairs; internal lobe approximately twice as wide as external one. Maxilliped (Fig. 2D): endite with subconical distal penicillium provided with fine hairs and subapical seta; palp with 2 setae in their basal article; distal part triangular with numerous sensillae. Pereopods (see male sexual characteristics). Uropods: sympodite reaching posterior edge of pleotelson.

Male: Pereopod 1 (Fig. 3A, B) not modified. Pereopod 7 (Fig. 3C) without modifications. Pleopod 1 (Fig. 3D) exopod subtriangular with concave external margin from their apical third; endopod with thick distal part, conical, striated, with fine setae in the middle part. Pleopod 2 (Fig. 3E): exopod with basal part rectangular, posterior lobe narrow with rounded apex; endopod sharply narrowed from middle and very small apical seta.

Remarks. This new species is included in the genus *Graeconiscus* Strouhal, 1940 due to its tergal ornamentation, which is characterized by two transversal rows of tubercles on the cephalon, 2+2 tubercles on the pereon-tergites 1–6, two paramedian tubercles on the seventh pereonite and a single central tubercle on the third pleonite (Schmalfuss et al. 2004). Currently, a total of 12 species are included in this genus, most of them initially assigned to other genera (see Schmalfuss et al. 2004; Alexiou and Sfenthourakis 2013). Almost all of them were originally described from islands, or continental sites, in Greece. *G. caecus* (Vandel, 1958), *G. guanophilus* Schmalfuss, Paragamian & Sfenthourakis, 2004, *G. kournasenseis* Schmalfuss, Paragamian & Sfenthourakis, 2004 and *G. strouhali* (Vandel, 1958) were found on the island of Crete (Aegean Sea). *G. dryoperorum* (Vandel, 1964) was initially described from the island of Evia, in the Aegean; *G. liebegotti* Schmalfuss, 1981, from the island of Gioura, in the northern Sporades; *G. multicostatus* (Karaman, 1961), from

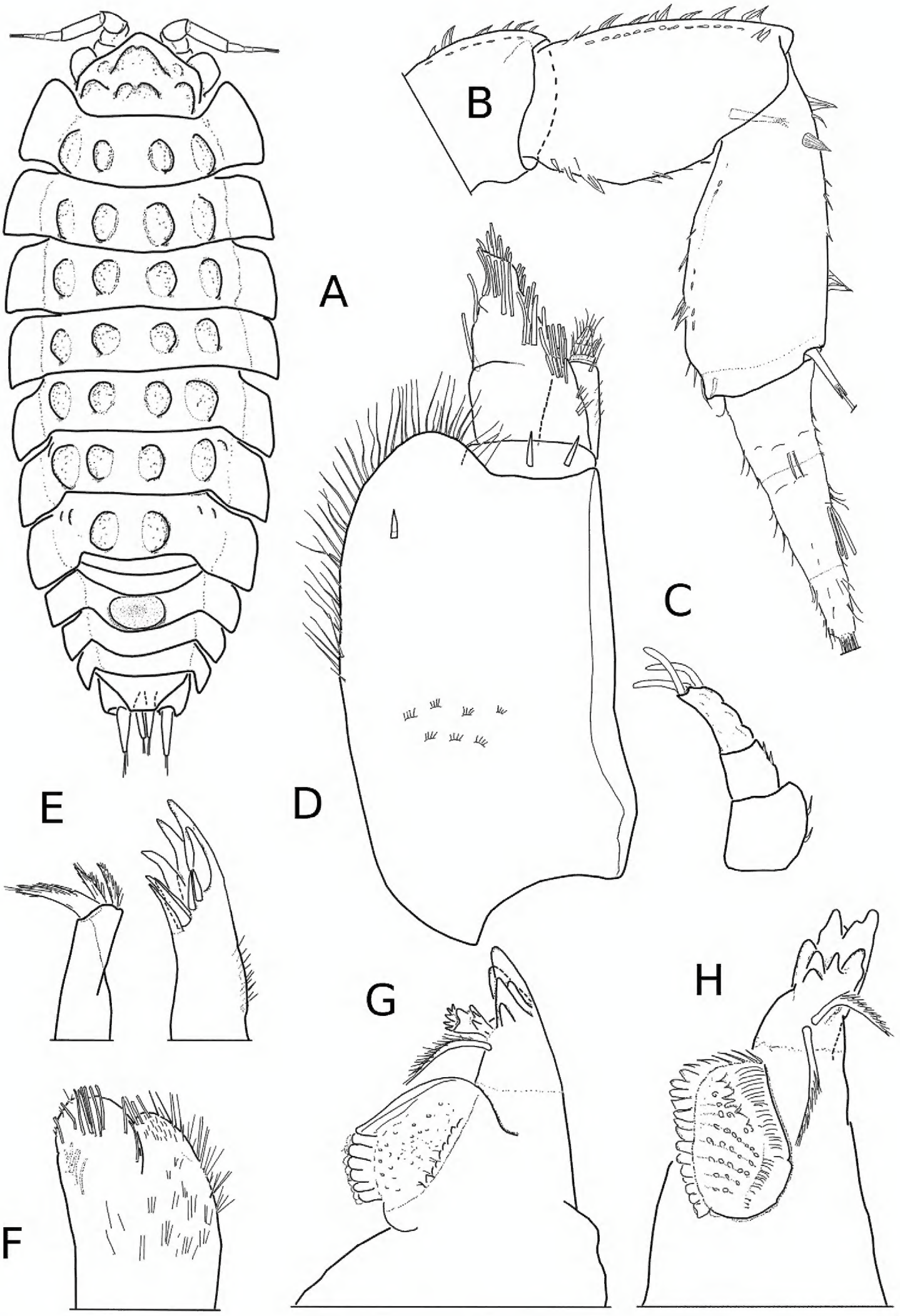

Figure 2. *Graeconiscus gevi* sp. nov. Male paratype **A** habitus, dorsal view **B** second antenna (apical cone omitted) **C** first antenna **D** maxilliped **E** first maxilla, distal portion of inner and outer endites **F** second maxilla, distal part **G** right mandible **H** left mandible.

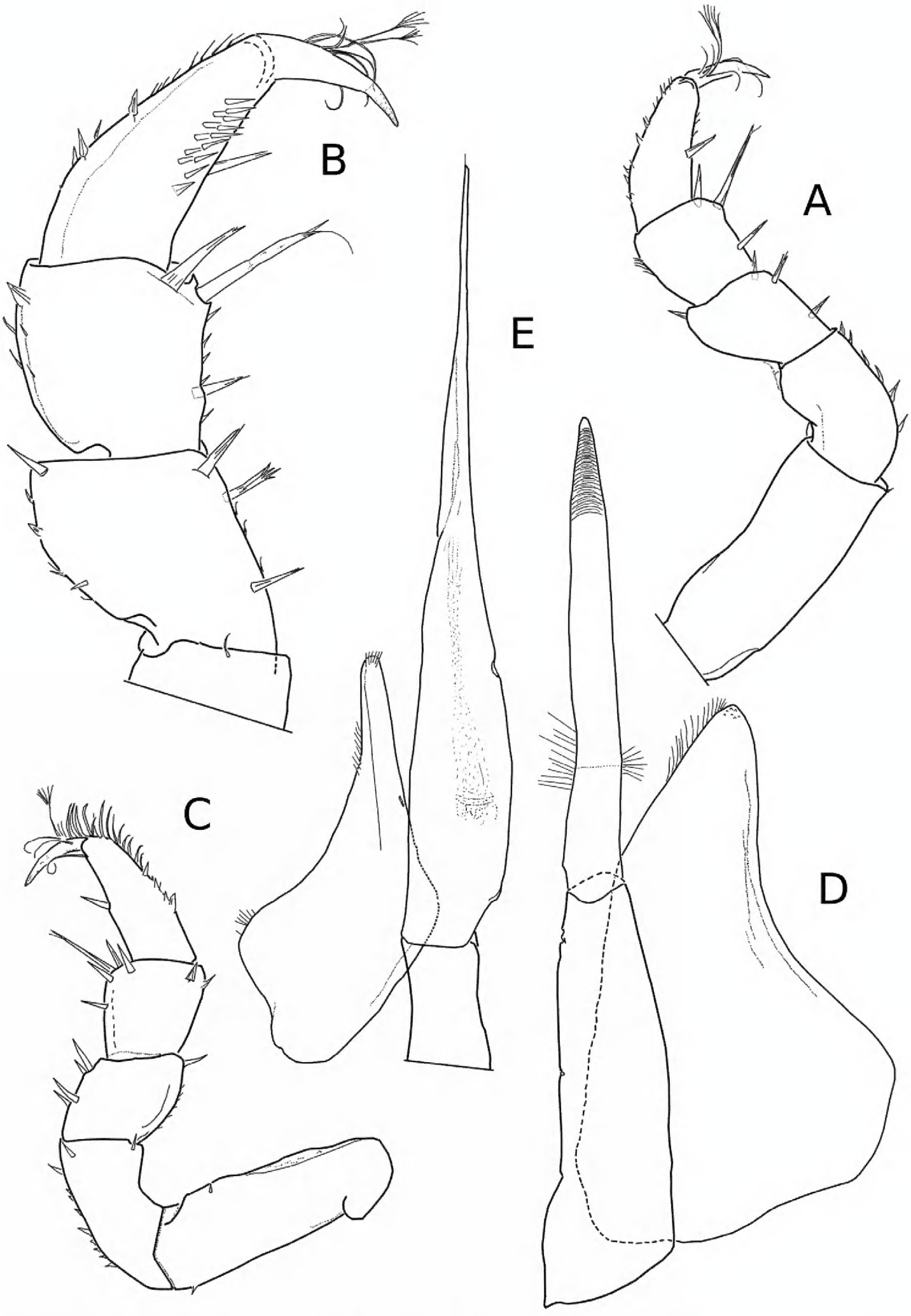

Figure 3. *Graeconiscus gevi* sp. nov. Male paratype **A** first pereopod **B** detail of meros, carpus, propodus and dactylus of the first pereopod **C** seventh pereopod **D** first male pleopod **E** second male pleopod.

the Titov Veles region, in North Macedonia; *G. paxi* Strouhal, 1961 and *G. tricornis* (Strouhal, 1936), from the island of Corfu; *G. strinatii* (Vandel, 1955) from the outskirts of Athens; *G. xerovunensis* (Strouhal, 1954) from NW Greece and, finally, *G. thermophilus* (Çaglar, 1948) was originally described from western Turkey and has been recorded in the southern Aegean islands, including Crete (Schmalfuss 2003; Alexiou and Sfenthourakis 2013).

Discussion

Graeconiscus gevi sp. nov. is morphologically closely related to *G. thermophilus*, which was initially included in the genus *Haplophthalmus* (Çaglar, 1948), and re-described by Strouhal (1963). The new species differs in that it presents a different pattern in the shape and dimensions of the tubercles of the pereon-tergites 1–7 and the single tubercle of the third pleonite (see Strouhal 1963 and Fig. 4E–H). In the central part of the cephalothorax *G. thermophilus* has two individualized tubercles wehereas in *G. gevi* there is a single, large central tubercle, slightly divided at the apex. *G. thermophilus* presents four clearly individualized tubercles in the posterior part of the cephalon, while in *G. gevi* sp. nov. the two medians are almost fused into a single tubercle. The ornamentation of the pereon-tergites 1–7 is similar in both species, but in *G. thermophilus* the protuberances are narrower, elongated, laterally compressed, reaching the hind margin of the pereonites and, in the seventh one, surpassing it, while in *G. gevi* they are located in the middle part of the tergites. The tubercle of pleonite-3 is small and transversal in *G. thermophilus* and highly developed in *G. gevi*. Finally, *G. thermophilus* is an oculated and slightly pigmented species and with more setose integument, characters that are not present in the new species. The male pleopods, appendages and mouthparts are very similar in both species. According to the redescription of Strouhal (1963), *G. thermophilus* does not show a thick honeycomb tegumentary structure. However in the specimens studied, the integument presents a honeycomb basal structure similar to that of *G. gevi* sp. nov. and of other Haplophthalminae (Fig. 4H).

The examined specimens of *G. gevi* sp. nov. are almost identical to those described, and fully illustrated, by Taiti and Rossano (2015) from a cave in northern Morocco, which were tentatively identified as *G. thermophilus*. These specimens from North Africa only differ from those of southern Spain by smaller and well-rounded tubercles of the posterior border of the head and the pereonites, instead of the more swollen and larger ones of the new species. The tubercle of pleonite III also presents the same differences. These small morphological differences may be due to geographic variability and do not seem to be sufficient to assign the Moroccan specimens to a different species from that of southern Spain.

The genus *Graeconiscus* was so far unknown in the Iberian Peninsula. Its presence in localities of the western Mediterranean (north Morocco and southeast Spain), contrasts with its apparent cantonment in southeastern Europe, some eastern Mediterranean islands and the Marmara region of Turkey.

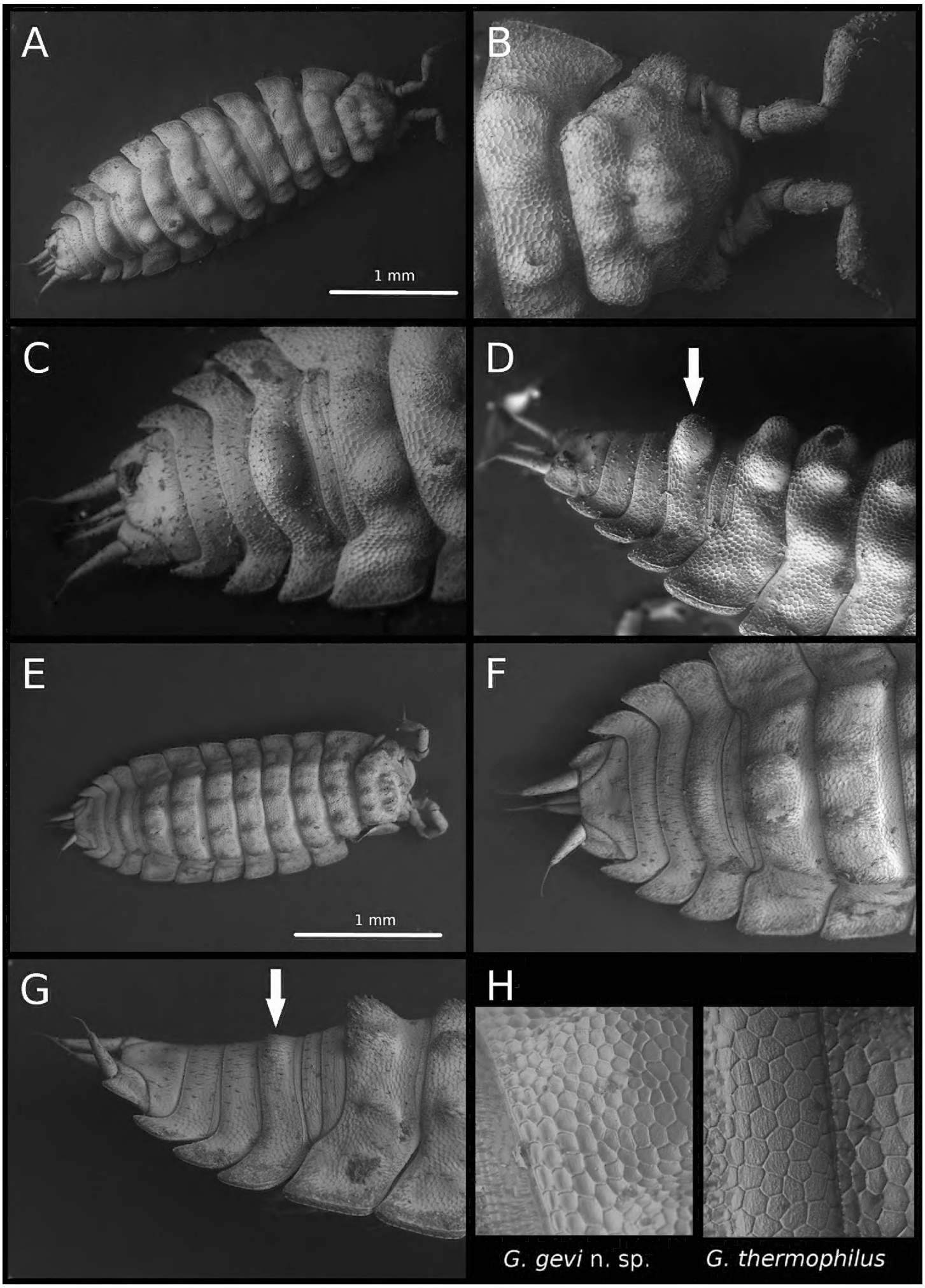

Figure 4. *Graeconiscus gevi* sp. nov., male paratype **A** dorsal view **B** cephalon, dorsal **C** last pereonite, pleon and pleotelson, dorsal **D** last pereonites, pleon and pleotelson, lateral view (arrow points the tubercle of third pleon-tergite) **E–G** *Graeconiscus thermophilus*, male specimen from Cyprus **E** dorsal view **F** last pereonites, pleon and pleotelson **G** last pereonite, pleon and pleotelson, lateral view (arrow points the tubercle of third pleon-tergite) **H** tegumentary basal structure (left *G. gevi* sp. nov.; right, *G. thermophilus*).

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